

13 pulse sequence provided by computer 110, under command of an operator thereof, directs the operations for echo generation and acquisition.--

REMARKS

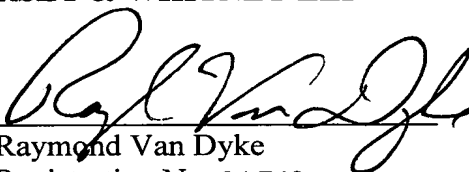
This *First Preliminary Amendment* is filed before the first Office action. The specification is amended herein to correct the one-to-one correspondence between the reference numerals in the figures and the reference numerals in the description. No new matter is added. A version with markings to show changes made is attached as an Appendix for the Examiner's convenience.

Respectfully submitted,

DORSEY & WHITNEY LLP

Date: October 12, 2001

By



Raymond Van Dyke
Registration No. 34,746
Suite 300 South
1001 Pennsylvania Avenue, N.W.
Washington, D.C. 20004
Telephone: (202) 824-8868
Facsimile: (202) 824-8890

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Please amend the application as follows:

IN THE SPECIFICATION:

Please replace the paragraph beginning on page 11, line 9, with the following paragraph:

--The present invention may be more readily understood with reference to FIGURE 1 in which an exemplary magnetic resonance imaging (MRI) unit 150 as implemented in a preferred embodiment of the present invention is generally depicted. A specimen aperture 155 is centrally located within the bulk of the MRI unit 150 scanning apparatus. Surrounding the specimen aperture 155 are gradient coils 180, transmitter coils 190 and receiver coils 195. The gradient coils 180 provide the gradient waveform for facilitating selective excitation, echo formation and localization, among other purposes, as is understood in the art. Generally, the gradient coils are responsible for generating the gradient field in corresponding axes in mutually orthogonal directions, e.g., designated according to the Cartesian x, y and z coordinates, and thus are driven independent from one another. The transmitter coil 190 is responsible for delivering the RF pulses into the aperture 155 at the Larmor frequency for providing excitation of the protons in the specimen, e.g., a human body. The receiver coil 195 is responsible for acquiring the signal generated from the excited protons during the proton relaxation period, as is understood. Driving these coils and interfacing the MRI unit 150 with a computer 110 is a scan controller 130. The scan controller 130 is the hardware that provides the real-time data delivery to and from the various equipment, e.g., digital to analog converters, as described more fully hereinbelow with reference to FIGURE 2. An iron yoke 170 completes the circuit by coupling the poles of the magnetic material of the plates [200]. It is understood that permanent magnets, as well as superconducting magnets, may be suitably interchanged for the resistive electromagnet.--

Please replace the paragraph beginning on page 13, line 1, with the following paragraph:

--With reference not to FIGURE 2, a more detailed illustration of the scan controller 130 [210] interfacing between computer 110 [200] and MRI unit 150 [220] is illustrated. Scan controller 130 [210] is in communication with computer 110 [200] over data links 202 and 204 for respectively sending and receiving digital data thereover, although a single bi-directional data link could be substituted therefore. Timing of all interactions, including

frequency and phase settings for the respective transmitter 190 and receiver coil 195, with MRI unit 150 is coordinated by synthesizers 230 integrated within scan controller 130 [210]. In a preferred embodiment, synthesizers 230 include two synthesizers which interface with two synthesizer DACs 231 and 232. The scan controller 130 [210] interfaces with three gradient DACs 240, 242 and 244, each providing a gradient field in mutually orthogonal planes, as well as two RF shaper DACs 250 and 252. To control and operate an advanced MRI unit as in the preferred embodiment, at least seven DACs are needed to transfer digital input between the scan controller 130 [210] and the MRI unit 150. However, the preferred embodiment is capable of numerous modifications and rearrangements which would require more or less than seven DACs. Gradient DACs 240 are supplied with digital gradient information describing the x, y and z gradient fields over respective gradient DAC input lines 241, 243 and 245, as defined by the MRI pulse sequence received by scan controller 130 [210] from computer 110 [200]. Gradient DACs 240, 242 and 244 then convert the digital gradient data to corresponding analog gradients which are transmitted to respective gradient coils 180 over gradient DAC output lines 246, 247 and 248. Thus, gradient DAC 240 is responsible for driving one gradient coil, e.g., gradient coil 180 X of the set of gradient coils 180. Likewise, each of gradient DACs 242 and 244 are responsible for driving a corresponding one of the remaining gradient coils 180, e.g., respective gradient coils 180 Y and 180 Z.--

Please replace the paragraph beginning on page 14, line 4, with the following paragraph:

--RF shaper DACs 250 and 252 are responsible for converting the RF shape data from the digital domain as defined in the MRI pulse sequence received by the scan controller 130 [210] from computer 110 [200] and modulating the representative RF shapes accordingly. The RF shapes are received and modulated by transmitter coil 190, generally at the Larmor frequency, to the subject specimen being analyzed in aperture 155. The frequency and phase of these modulations are controlled by synthesizers 230 over control lines 260 and 261. The echo resulting from the applied gradient waveforms and RF pulses is acquired by the receiver coil 195 during the relaxation periods and accordingly transmitted to the scan controller 130 [210]. Proper acquisition of the echo is facilitated by frequency and phase settings applied to the receiver channel by synthesizers 230. These frequency and phase settings are supplied to the scan controller by the MRI pulse sequence data received from computer 110 [200]. Thus, the MRI pulse sequence provided by computer 110 [200], under command of an operator thereof, directs the operations for echo generation and acquisition.--